

DOMINION OF CANADA  
DEPARTMENT OF AGRICULTURE  
EXPERIMENTAL FARMS  
DIVISION OF BOTANY

---



# THE DISEASES OF TOMATOES

BY

W. A. McCUBBIN, M.A.

FIELD LABORATORY OF PLANT PATHOLOGY

ST. CATHARINES, ONT.

BULLETIN No. 35

Second Series.

---

Published by direction of

Hon. T. A. CRERAR, Minister of Agriculture, Ottawa, Ont.

---

OTTAWA

J. de LABROQUERIE TACHÉ  
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY

1918



DOMINION OF CANADA  
DEPARTMENT OF AGRICULTURE  
EXPERIMENTAL FARMS  
DIVISION OF BOTANY

---

# THE DISEASES OF TOMATOES

BY

W. A. McCUBBIN, M.A.

FIELD LABORATORY OF PLANT PATHOLOGY

ST. CATHARINES, ONT.

BULLETIN No. 35

Second Series.

---

Published by direction of

Hon. T. A. CRERAR, Minister of Agriculture, Ottawa, Ont.

---

OTTAWA

J. de LABROQUERIE TACHÉ  
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY

1918

AGRICULTURE  
RECOMMENDED TO TREATMENT  
SUGAR BEET  
SUGAR BEET

SOURCES OF INFORMATION.

For information on methods of culture, varieties, fertilizers, and general practice, write to

THE DIVISION OF HORTICULTURE,

Central Experimental Farm,  
Ottawa, Ontario.

For identification and treatment of diseases, preparation of Bordeaux mixture and other sprays, and soil sterilization, consult the

DIVISION OF BOTANY,

Central Experimental Farm,  
Ottawa, Ontario.

For insects and their control, the

ENTOMOLOGICAL BRANCH,

Department of Agriculture.  
Ottawa, Ontario.

(Letters addressed as above, or packages of specimens not exceeding 12 ounces in weight, will go postage free.)

TO MATO DISSEYSES

MINISTER OF AGRICULTURE

OTTAWA, June 6, 1918.

The Honourable  
The Minister of Agriculture,  
Ottawa.

SIR,—I have the honour to transmit herewith the manuscript of Bulletin 35, of the second series, entitled "The Diseases of Tomatoes" and prepared by Mr. W. A. McCubbin, Assistant-in-charge of the Plant Pathological Laboratory at St. Catharines, Ont.

A publication on the above subject will be a most welcome and, indeed, a necessary addition to our bulletins of a technical character, and I would recommend that a limited edition be issued at an early date, so that the information contained may be available this season.

I have the honour to be, sir,

Your obedient servant,

J. H. GRISDALE,  
*Director, Dominion Experimental Farms.*

	PAGE.
<i>Fertilizer Injury</i> .....	14
(b) Usually in young plants before setting out.	
* <i>Damping-off</i> .....	10
(c) Fungus visible about the injury in the field.	
°* <i>Rhizoctonia</i> .....	11
or °°* <i>Sclerotium Blight</i> .....	11
II. The stem not showing injury at the ground.	
(a) Soil very wet for some time, roots and rootlets browned and dead; inner tissue of larger roots water-soaked.	
<i>Wet Feet</i> .....	15
(b) Soil not excessively wet and root system apparently normal; when the stem is cut across the hard fibres in it are discolored (compare with a healthy stem).	
°The fibres are light brown in colour.	
* <i>Sleeping Disease</i> .....	9
°°Some or all of the fibres are blackened.	
* <i>Bacterial Wilt</i> .....	10
B.—Only parts of plants wilting, typically above or connected with evident blight on stems, branches, or leaf stalks.	
* <i>Late Blight</i> .....	12
9. The leaves are yellowed and sickly, without spots or blights to cause this condition.	
A.—Leaves normal in size; only lower leaves yellowing; either maturity of the leaves or early stages of stem or root troubles (See under leaves 8AI and II).	
B.—All leaves smaller than usual and yellow.	
I. This condition general in the field. The plants lack light food or moisture, or there is excessive wet.	
II. Only on individual plants; general conditions good. Look for wilt or stem troubles (See 8AI and II).	
<b>On the Roots—</b>	
1. Small round nodules on the rootlets; about as big as a pin head or larger.	
<i>Eelworms</i> .....	16
2. Roots and rootlets brown in wet soil; inner tissue of larger roots water-soaked or discoloured.	
<i>Wet Feet</i> .....	15
3. The Collar (where the stem and root join at or below the ground surface) injured, browned, or with visible fungus growth on it.	
A.....	10
B.....	11
C.....	11
D.....	14
* <i>Damping-off</i> .....	
* <i>Rhizoctonia</i> .....	
* <i>Sclerotium Blight</i> .....	
<i>Fertilizer Injury</i> .....	

### On the Stems—

1. There is injury at the collar, where the stem and root join (See No. 3 under "Roots").
2. Dead or dark streaks in the stem.
  - A.—These dark strips are associated with the streak disease in the leaves.
  - Streak.....
  - B.—The streaks run definitely from a wound, or from the base of a dead shoot or leaf stalk.

	<i>Stem Blight</i> .....	16
3. Spots occur on the stem (associated with leaf spot on the leaves).	<i>Leaf Spot</i> .....	7
<b>On the Fruits—</b>		
1. The fruit has spots on it, i.e., small browned or discoloured areas on the surface.		
A.—The spots very dark, raised, affecting the skin only.	<i>Fruit Scab</i> .....	15
B.—The spots are small and more or less sunken.		
I. Irregular, deep, associated with streak in the leaves.	<i>*Streak</i> .....	14
II. Developing small black pimples.	<i>Anthracnose</i> .....	12
2. Cracks occur in the skin.	<i>Growth Irregularity</i> .....	15
3. The surface of the fruit exposed to the sun is flattened and dry; the skin of this area is sometimes papery; and the whole area often turns black.	<i>Sunscauld</i> .....	13
4. Portions of the fruit are rotted.		
A.—Rot typically at the blossom end (the end opposite the stem) often associated there with irregularity of growth; rotted tissue occasionally soft and watery but usually black and tough.	<i>Blossom End Rot</i> .....	9
B.—Rot spots anywhere on the fruit.		
I. Rot spots very black, flattened or sunken, often starting around injuries, rotted tissue tough or leathery.	<i>Black Rot</i> .....	8
II. Rot not black and tough but soft and watery.		
(a) <i>*Fusarium rot</i> .....		9
(b) <i>*Bacterial Rot</i> .....		
(c) <i>*Late Blight rot</i> .....		12
III. Rot spots chiefly where fruit touches the ground; brown and blotchy in appearance, not deep.	<i>Rhizoctonia Rot</i> .....	11
IV. Rot areas uneven or wrinkled often starting from several near-by spots.	<i>Anthracnose</i> .....	12
V. Rot area with a dark, sunken, black-specked centre, surrounded by a water-soaked zone.	<i>Phoma rot</i> .....	9

#### LEAF SPOT (*Septoria lycopersici* Speg.)

As the name indicates this fungus causes numerous spots on the leaves. The spots are usually rounded, are lighter in the centre than at the edges, and often have a roughened appearance (Fig. 1). The disease starts on older, weakened leaves, and may spread all over the plant as time goes on. When badly attacked the leaves turn yellow, die, and fall, so that soon bare stems only are left. The same fungus also causes spots on the stems or even on the fruit.

The fungus is present in every tomato field more or less, but in the Niagara peninsula it is rare to find an early attack on any but the older weakly leaves

which are shaded or near the ground. Leaf spot seldom becomes plentiful until late in the season when the whole plant has become weakened with the effort of fruit production. At this season the damage to the crop is of much less importance than where the disease is prevalent on the growing young plants.

In the Niagara peninsula the damage from this disease would scarcely warrant spraying. In other places the Leaf Spot may be more troublesome, in which case it may be held in check by using 4-4-40 Bordeaux mixture, the first application being given in the seed bed, and others at intervals of about ten days during the growing season.

It is also advised not to plant tomatoes again for several years on land where the disease is prevalent.

### LEAF SPOT (*Cylindrosporium* sp.).

Very uncommon but may occur in sufficient amounts to be worth notice here and there. The spots are of a more uniform brown than the ordinary leaf spot due to *Septoria*, and are not so thickly scattered over the leaf.

### TARGET SPOT, BLACK SPOT, FRUIT ROT (*Alternaria solani* E. and M.).

This fungus causes both a leaf spot and a fruit rot, and damage in both ways is not uncommon, though the rot of the fruit is by far the most important.

The rot on the fruit starts usually in some small wound or crack, most often in the punctures or bites made by insects. The resulting rot spot slowly increases in size and becomes flattened and very black, while the rotted tissue has a tough leathery texture (Fig. 2). Blossom End Rot (Fig. 3) is a complex disease in which this fungus plays a prominent part, invading the injured tissue and forming there its characteristic flattened or depressed and very black rot spot. Aside from its damaging effects in connection with the Blossom End Rot the fungus causes considerable loss also from rot spots started elsewhere on the fruit at insect injuries or some break or crack in the skin. The worst cases of this rot seen have always been in early tomatoes which were allowed to become very weedy towards the end of their season. It is probable that the weed growth harbours insects besides providing a moist cover favourable to infection by the rot fungus. In a recent article (Research Bulletin No. 42, Agricultural Experiment Station, University of Wisconsin) it is stated that the spores of this fungus germinate in  $1\frac{1}{2}$  hours and that it spreads most rapidly in weather that is cloudy and wet for a couple of days. This explains to some extent the pronounced occurrence of this rot in early tomatoes and in weedy land.

On the leaves this fungus causes rounded spots which are often quite large. They may be over half an inch in diameter, but are not likely to be very numerous on any one leaf. They are readily distinguished by their size, and especially by the peculiar ring-like or concentric markings, which have resulted in the name of "Target Spot." These spots may occur about the edges of the leaves in some cases and then their features are not so distinct, since they form more irregular dead areas which are torn or lost, leaving only a ragged edge on the leaf.

Since this same fungus is ascribed as the cause of the Early Blight of Potatoes and it is said to be carried over the winter on old dead leaves and rotten fruit, care in destroying or burying all this affected material will be of great assistance, especially where another tomato crop is planned to follow tomatoes or potatoes.

Spraying with Bordeaux as given for Leaf Spot will of course give a measure of protection, but according to the experience of the numerous growers in the Niagara peninsula cleanliness and proper rotation are usually sufficient to safeguard the crop against the disease.

FIG. 1.



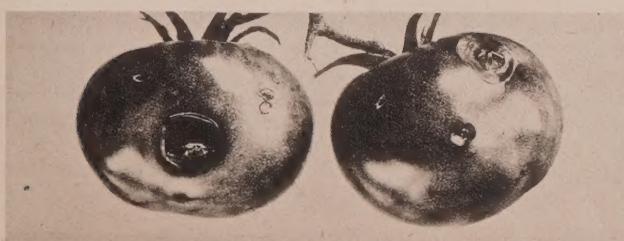
TOMATO LEAF SPOT. In bad attacks the leaves turn yellow, dry up and fall off.

FIG. 3.



BLOSSOM END ROT  
(After Brooks.)

FIG. 2.



BLACK ROT. The three upper fruits show the rot as it occurs in the field, the rot spots in the two lower fruits were produced by inoculation with cultures of the fungus.



### BLOSSOM END ROT, POINT ROT (Cause not fully determined.)

This trouble is often very serious both in the field and in greenhouse plants. The cause is generally considered to be due to irregularities in the water supply. Alternations of plenty and scarcity are said to bring about sap pressures which rupture the tender tissues around the blossom end of the fruit, after which fungi and bacteria are able to enter and turn the injury into a definite rot spot (Fig. 3). In the early stages of the disease the tissue of the blossom end of the fruit has a blotchy, water-soaked appearance, and if no rot infection occurs it may recover from this condition without other result than some more or less inconspicuous growth deformities. In most cases, however, bacteria or fungi, or both, invade the ruptured tissue and cause a definite rot which will either greatly disfigure the fruit or destroy it completely. Usually it is the black rot fungus (see p. 8) which is prominent in this second stage of the disease, though not always.

On account of the fact that the conditions to which the early stages are attributed are apt to be general, this disease is likely to be sudden and severe, and it is in some seasons responsible for very large losses. In the field apparently little can be done to check the trouble but in greenhouses the irregularities of water supply which seem to be connected with the early stages can readily be avoided.

### PHOMA ROT (*Phoma destructiva* Plowr.).

Farther south this rot has been met with to some extent and, on account of the yearly importation of early southern tomatoes, it may be introduced here. In one case reported by H. T. Güssow a carload of Florida tomatoes entered Montreal, in which practically all the fruits were attacked by this rot. It is chiefly known as a fruit rot, though the fungus may attack the leaves and produce spotting. On the ripe fruit dark, sunken spots are produced. The older spots are dark in colour and are surrounded by a zone of water-soaked tissue. In the dark centre are to be found numerous black or brownish specks, the spore-bearing organs (Fig. 4). On green fruits the spots are smaller and the water-soaked border is not so evident. The fungus is apparently able to enter the skin of the fruit only through wounds or insect punctures, and will therefore seldom become a serious pest. Leaf spot infection may take place more readily. Irregular, blotchy, dead areas are produced, and when these are plentiful the leaves are cast. On both leaves and fruit infection takes place most readily under humid conditions.

Destruction of old diseased plant material would appear to afford sufficient protection from this disease.

### FUSARIUM ROT.

Besides the common Black Rot (see Fig. 2) there is also a rot of ripe tomato fruits due to species of *Fusarium*. This fungus causes a wet rot, in which the part affected retains its shape but becomes soft and watery. When the skin is broken a watery juice is exuded and often the fungus forms a whitish, wet crust around such a break. This rot spreads very rapidly and soon involves the whole fruit. While there is a small yearly loss from this rot it is rarely serious and no control measures can be suggested that would be profitable, beyond cleanliness in disposing of the rotten fruits and a proper rotation of crops.

### SLEEPING DISEASE, WILT (*Fusarium lycopersici* Sacc.).

This trouble is due to a fungus which gets into the stalks from the soil by way of the roots, and clogs the sap-conducting tissues, thereby bringing about a wilting and slow death of the tops. Very often the plants are attacked in the seed bed but do not show much sign of the trouble till they are set out for some time. When hot, dry weather occurs the fungus in the sap channels prevents

the upward passage of sufficient water for the top, and the leaves wilt, or turn yellow and finally fall off (Fig. 5). Often weaker portions of the leaves are killed by the hot sun, and the foliage becomes curled or rolled in a very striking way. In all cases the crop is greatly reduced and the plants are likely to die completely.

If the stem of a wilted plant is cut across the woody fibres in it are seen to be browned by the presence of the fungus. Even in seedling plants this browning of the conducting tissue can sometimes be seen by holding the plant up to the light.

The fungus lives in the soil, often for years, and is likely to enter the plants after they are set out in an infected field. An infected seed bed is of course likely to be responsible for greater damage since a larger percentage of the plants will be affected, and they are attacked at an earlier period of growth.

In the more southern districts of the United States this wilt disease is very damaging. Although a few cases of it have been met with in Ontario it does not yet appear to be general or important, and we venture to hope that our severe climate has something to do with the immunity we seem to have had up to the present. This is the more fortunate since the disease is very difficult to control. It is due to a soil-inhabiting fungus, and past experiences seem to indicate that the only satisfactory method of meeting diseases of this kind is to breed resistant strains of plants. Some progress has already been made along this line in southern Illinois by the University of Illinois. By crossing several varieties strains showing considerable resistance to the disease have been secured.

Where isolated cases of the disease are met with it is good policy to pull and burn all the affected plants in order to prevent the spread of the fungus as far as possible.

#### BACTERIAL WILT (*Bacillus solanacearum* Sm.).

The plants wilt during the day and then partially revive during the night for two or three days, after which they soon die. This disease is much like the sleeping disease in appearance, except that the sap-conducting fibres of the stem are clogged by a bacterium instead of a fungus. In this case the discoloration in the woody fibres is black and not brown as in the Sleeping Disease, and when such a stem is cut across squeezing will often cause a slimy material to ooze from the end of the blackened fibres. Observations made to date indicate that it is not at all general in Ontario.

#### OTHER WILTS.

Aside from the natural wilting of plants when subjected to drought there are several other causes which bring about wilting of the tomato tops. *Rhizoctonia* is sometimes found to cause wilt, while wilt symptoms may be expected to occur in connection with damping-off diseases, or with fertilizer or other stem injury, where the tissues are interfered with to such an extent that the flow of sap is lessened.

#### LEAF BLOTCH, BROWN MOLD (*Cladosporium fulvum* Cke.).

This pest is quite common in greenhouses but often occurs to a lesser extent in the field. As the name implies, the fungus grows as a mold in patches on the leaves, on either side, but most generally on the lower surface. The mold is whitish at first but it soon turns yellow and finally forms a brown velvety coating. The part of the leaf covered by it takes on a sickly yellow discoloration as seen from above, and this area dies and turns brown. When present in quantity the leaf surface is so reduced that the yield is greatly lessened.

Owing to the immense numbers of spores produced by this fungus it spreads very rapidly when it once becomes established. Moisture and warm, stagnant air favour its development, and as these conditions are likely to prevail in

FIG. 6.



FIG. 4.



PHOMA ROT  
(After Jamieson.)

Typical case of filiform or  
spindly leaf, associated with  
the Mosaic disease.

FIG. 5.



A WILTED PLANT  
(After De Baun.)



greenhouses the disease is most damaging under glass. In the field it is met with less frequently and is to be seen especially on the early crop. It is apt to be worst in weedy or low land, or following continued moist, foggy weather.

Greenhouse conditions call for particular attention in the matter of control. The first thing to be considered is cleanliness, involving destruction by burning of the old molded plants, so as to destroy as many of the spores as possible. A thorough hose washing of the interior will also help in this regard. In the next place the matter of ventilation is most important. Experience has shown that the greatest factor in keeping down the Leaf Blotch is to provide for thorough ventilation while the plants are growing. In most cases this will give adequate protection but, if not, the disease may be controlled by spraying with Bordeaux mixture. If this is found necessary it should be begun on the first appearance of the Blotch; when the fungus has made a good start even careful spraying is likely to give disappointing results. Two or three sprayings at one to two weeks' interval will be needed. Finally avoid watering from above; the hose stream will wash the spores about and the film of water left on the leaves helps them to germinate.

#### DAMPING-OFF (*Various fungi*).

Damping-off is a trouble in which some fungus or bacterium attacks the young plant at or near the surface of the ground and destroys the stem to such an extent that the plant falls over and dies. Several fungi of similar habits are apt to injure young tomato plants in this manner.

Changing the soil of the seed bed will often help in such cases, especially if the new soil used is free from the fungus. In such a case it is advisable to spray or drench the sides and bottom of the bed with formalin solution, 1 pound (or one pint) to 10 gal. water. A more effective method of dealing with damping-off troubles is to sterilize the soil of the bed, either with the formalin solution just mentioned at the rate of a gallon to the square foot of surface, or else with steam. Damping-off troubles are also often reduced by keeping the upper soil layer dry, or by covering the bed or flat with sand to a depth of half an inch or more, in both cases watering from below. Where damping-off troubles are present among young plants and a large proportion of them have been killed it is advisable to get fresh stock for setting out if possible. If this can not be done, or if the damping-off has been limited in amount, the healthy plants only should be used, particular care being taken to see that the stalks of these are in no way affected by the trouble. Since damping-off diseases are usually only serious in the younger stages of growth, it may be expected that those plants which have passed the susceptible period safely will not be attacked afterward.

#### ROSETTE, RHIZOCTONIA (*Rhizoctonia* sp.).

The fungus which causes the yellowing and wilting of potato tops, often with the formation of "little potatoes" on the stem, is well known in Ontario. This or a very similar fungus may cause rosette in tomatoes by partially girdling the stem at or near the soil surface. Plants which are affected have leaves which are yellowed and dwarfed, and in severe cases in dry weather the leaves may wilt. In such cases the fungus may be seen as a scanty or thick interwoven felting of dark filaments around the base of the stem, which is browned and injured by its presence. Destroying diseased plants and changing or sterilizing the soil are the only control measures that can be suggested.

#### SCLEROTIUM BLIGHT (*Sclerotium* sp.).

Not yet recorded in Ontario, but reported from Ohio greenhouses and may appear here. The fungus attacks the stem near the ground and the first evidence

of its presence is the wilting of the ends of the plant, which finally dies. The fungus forms on or in the stem tissue small roundish bodies, white at first, then turning dark. It is advisable to burn all plants found diseased in this way.

#### ANTHRACNOSE (*Colletotrichum phomoides* (Sacc.) Chester).

This fungus causes a number of small, sunken, dark spots on the fruits, disfiguring them and injuring their keeping qualities. The same fungus may be found on the other parts of the plant, but it is most important as a fruit disease. At first the spots are small and shrunken but, as they enlarge, they join together to produce a general decay, often with a wrinkled surface. In the earlier stages the spots may have small black specks which are the spore-producing organs, but later these may become so numerous as to form a continuous spore-bearing area.

This disease is likely to occur when the fruit is ripe or nearly so. It appears to be unimportant as yet in the tomato sections of Ontario, though further south it has been noted to some extent. If the disease is locally severe over several years, and care in disposing of all old infected material in the fall does not check it, it may be controlled by the use of Bordeaux mixture applied before the spots appear in quantity, and several times thereafter at weekly or ten-day intervals.

#### LATE BLIGHT (*Phytophthora infestans* DeB.).

This serious potato disease is known to occur on the tomato occasionally, where it causes the death of the plant much as in the potato. It appears suddenly as dark discoloured watery spots on the fruit, leaves, and branches. There quickly follows a death of the affected parts, and in the case of the fruit a destructive rot sets in often accompanied by a white mold on the surface of the rotted part.

Damage from this disease seems to be infrequent in the Niagara peninsula, although cases are recorded occasionally from there as well as elsewhere in the province. Spraying with Bordeaux is the treatment for this disease as on the potato (see Leaf Spot, p. 8).

#### MOSAIC DISEASE (Cause unknown).

The mosaic disease of tomatoes is very common in greenhouse plants and much less so in the field crop. Though often present in the field in small amounts, it is only occasionally so prevalent that a considerable lessening of the crop occurs. Surveys made in the tomato fields of the Niagara peninsula in 1915 and 1916 covering about 18,000 plants showed the disease to be present in 3.4 per cent of those examined or one plant in about thirty.

Out of the 53 fields examined in the two years the disease was present in 17. The largest amount of disease found was 55.5 per cent in 1915 and 47 per cent in 1916. These results show that while the general amount of Mosaic may be comparatively small, individual fields may be badly attacked.

The lessening in crop due to the disease was investigated in 1915 through the kindness of the Director of the Vineland Horticulture Experiment Station, who undertook to ascertain the number and weight of the fruit from equal numbers of healthy and diseased plants. His figures are appended.

	59 healthy plants.	59 diseased plants.
Number of fruits.....	7,135	4,740
Weight of fruits.....	819½ lbs.	599 lbs.

Increase of healthy over mosaic plants in number of fruits 36.8 per cent.

Increase of healthy over mosaic plants in weight of fruits 40.5 per cent.

FIG. 7.



STREAK IN LEAVES AND FRUIT. The brown areas in the leaves are typical of more advanced stages. In earlier stages the brown spots are small.

FIG. 8.



SCAB ON FRUIT. In the upper left, advanced stages are shown, in the other two fruits the beginnings of the scab spots are figured.



It will be readily seen that these figures indicate a pronounced decrease in crop due to the disease, and it is significant that, since in the field in question only a slight difference could be observed before the actual counting and weighing was done, growers are apt to suffer a great deal more than they think by the presence of this disease.

In a mosaic plant the leaves are seen to be mottled, that is, the normal dark green of the leaf has streaky areas of paler yellowish green here and there. In some cases the normal dark green areas grow faster than the sickly yellowish portions so that the leaf has a lumpy or irregular look. Another symptom of somewhat rare occurrence is also associated with this disease—the so-called "filiform leaf," "spindly leaf," or "grass leaf," in which the blade of the leaf becomes much reduced in breadth, often so much so that it is a mere ribbon (Fig. 6). The disease of itself does not kill leaves or stems, but may weaken them so that they are readily affected by drought or sun-burn.

The following points about the mosaic disease are worth noting as they give a clue to control:—

(1) The disease has not been shown to be due to bacteria or fungi. The real cause is yet unknown.

(2) It can however be readily transferred from one plant to another by inoculating a healthy plant with the juice of a diseased one. Such transfer is apt to take place in the field by means of insects, or by using tools, or handling the plants, or cultivating among them, any of which agencies may transfer a small amount of juice from diseased to healthy vines.

(3) So far as is known the disease does not pass through the seed.

(4) Mosaic appears to winter in two ways—either in the field (in soil or old plant parts), or in the seed bed. The first method does not seem to be of serious importance, but it is not advisable to grow tomatoes on land where the mosaic disease has been bad the previous year. Seed bed infection on the other hand seems to be responsible for all the bad cases of the disease yet seen. The common practice of adding new soil to that of the old tomato seed bed is what causes the trouble, since the old soil carries the disease. Danger from this cause can be readily avoided by completely changing the seed bed soil as soon as the disease appears in the field. This discarded soil is apparently harmless for other plants.

#### SUNSCALD (Climatic).

When tomatoes have a scanty water supply and the sun is very hot, the exposed surfaces of the fruits may be scalded. It should be noted here that with plenty of water the tissue of the fruit will withstand the sun's heat without injury, but the same tissue is readily killed when the water supply fails.

The injured surface is flattened and the skin becomes dry and papery. Later on these spots may turn dark because of invasion by rot fungi (see under Black Rot, p. 8), but in many cases they ripen normally except for the flat, dead area on one side. Such fruits are much disfigured for market but are not seriously injured for canning purposes, as in most cases proper ripening will take place afterwards if rot does not follow.

Sunscald has been noted several times along the stems of plants which were either set out in a very soft condition or else subjected to a slight frost. In the latter case the injury was due to the action of the warm, morning sun on slightly frosted tissues and the injury was all on the "sunrise" side of the stem.

On this side a long dead strip was formed, the skin of which was often dry, white and papery. Though severely checked for a time these plants afterwards recovered and thrived well.

The hot sun of summer affects tomato plants in other ways. Leaves which are suffering from lack of water, either because of drought or because the

plant has some "wilt" trouble (see Wilts, pp. 9-10), are often killed by the sun's action. Such leaves turn brown and shrivel up and the plant takes on a blighted look.

Under conditions where shaded foliage or stems or the under sides of the leaves are suddenly exposed to strong sunlight they develop a pronounced bronze or purple colour often with a silvery surface, the effect in general resembling that of a beet leaf.

### STREAK DISEASE (Cause unknown).

The Streak disease is largely a leaf trouble and is mainly confined to greenhouse tomatoes. It is present in Ontario greenhouses in quite a few cases and has been very damaging to the crop. It is well known in the Eastern U.S. and has long been troublesome in Europe.

The name "streak" is fairly appropriate (Fig. 7). Small dead spots or streaks appear in the leaves, often occurring to such an extent that the leaf shrivels and curls. As the spots may appear when the leaf is very young the leaf development is hindered, and a badly affected plant will have small sickly leaves which soon die and drop off. Dark streaks may often be seen on the stems, and occasionally on the fruit. When the fruit is affected it shows dark, streaky spots which are usually sunken because the tissue involved has not grown as fast as the surrounding healthy flesh (Fig. 7). These dark streaks may run a considerable way into the fruit, often in an irregular fashion. Rots frequently start at the streak spots and, in any case, the affected fruits will be small, deformed, and of poor quality.

There is no evidence that the disease is of a parasitic nature, since it apparently does not spread from one plant to another. One of our prominent growers claims that he has been able to eliminate Streak from his greenhouse by giving the plants more heat, especially at night, while others state that they can keep free from it by thorough ventilation. Recent investigations carried on by the Department of Botany at the Ontario Agricultural College indicate that it may be due to unbalanced food supply, and there is good reason to believe that these investigations will result finally in a satisfactory means of controlling what has heretofore proved to be a very damaging and difficult trouble.

## VARIOUS MINOR TROUBLES.

### FERTILIZER INJURY.

In order to ensure a quick and early start many growers are in the habit of applying some commercial fertilizer rich in nitrogen around the tomato plants just as they are set out. If this is carelessly sprinkled on the ground some of it may fall against the stems and burn them. Several slightly different cases are known where great loss has resulted from this type of injury. A light rain dissolved the fertilizer and left a concentrated solution of it in the depression around the stem. The strong chemical destroyed the tender stalks completely and the plants died.

Both to ensure quick action and to prevent such injury it is wise to sprinkle such fertilizers in a ring at some distance out from the stem and to cover with a little soil. The moisture in the soil gradually dissolves the fertilizer and the weak solution resulting is harmless to any part of the plant, while the food materials in it are more immediately available to the roots than if left on the surface to be dissolved by rains.

### LEAF MOLD (*Fumago vagans* Pers.).

Occasionally the leaves of greenhouse tomatoes are over-grown by a dark mold. This is mainly on the upper surface of the leaves and may be especially

plentiful where plant lice are numerous, as the mold grows readily in the sticky secretion left by these lice. It is not a parasite and apparently does little harm. This mold may be distinguished from the destructive Leaf Blotch fungus by its evident harmlessness; by the fact that it is usually on the upper surface of the leaves, while the Leaf Blotch fungus occurs principally on their lower surfaces; and by its being always very dull black in colour while the Blotch fungus is first light in colour, then yellow brown, and finally brown.

#### BLACK SCAB SPOTS (Cause undetermined).

In several cases tomato fruits have been observed on which there occur very black, raised, scab-like spots (Fig. 8). These affect the skin only and do not injure the flesh below, but they disfigure the fruit so that it can only be used for canning. The spots are apparently started at insect punctures in the skin but the later development of these punctures into the deep black scabs has not been followed out. The worst cases of this trouble were seen in fields near Walkerville, Ontario.

#### OTHER FRUIT ROTS.

A rot much similar to the *Fusarium* rot seems to be caused by bacteria. The rot that is sometimes caused by the Late Blight fungus is mentioned elsewhere (see p. 12). *Rhizoctonia* is also reported to cause rot of the fruit, especially where the fruit lies on the ground. The rot in this case is mostly confined to the tissue near the surface, which becomes brown and blotchy. The grey mold fungus (*Botrytis*) and *Sclerotinia* are also reported to be minor causes of rot.

The avoidance of these rots is mainly a matter of cleanliness in disposing of the old fruits, and of crop rotation to avoid exposing a new crop to the contamination left by rotten fruits of the preceding year.

#### OEDEMA.

In this disease the veins and tissues of the leaves swell from excessive growth, and the leaves curl in an abnormal fashion. It is apparently due to excess of water, lack of light, and warm rich soil. It is mostly found in greenhouses and is readily controlled by careful management.

#### LEAF ROLL.

A peculiar thickening and upward rolling of the leaves is met with frequently in the field. The tissues of these leaves are much thickened and they are likely to be firm and brittle in texture. It affects only a few leaves on the plant, usually those in the centre of the vine towards the base. When the curling of these leaves exposes parts of their lower surfaces to the sun the exposed portions are likely to become bronzed from the action of light. This trouble is apparently unimportant, as the upper leaves on such plants are quite normal and there seems to be no appreciable effect on the crop.

#### WET FEET.

Excessive and continued wet may bring injury to the root system, and with the death of the rootlets and root hairs the power of the plant to absorb water is so reduced that wilting may occur even though the plant is standing in very damp soil. Much injury of this sort was met with in 1915.

#### CRACKS

in the fruit are very unsightly. They are due to uneven growth caused by alternations of wet and dry conditions. When rain comes after a dry, hot period,

the development of the skin lags behind the increased growth of the tissue of the fruit, and a pressure arises which bursts the skin. Cracks of this nature are often a starting point for rots of various kinds. Proper attention so as to ensure a uniform progress in development would be possible in the case of greenhouse culture.

#### EELWORMS

are not uncommon on tomato roots, especially when grown under glass. When present they irritate the rootlets, causing the formation of galls from the size of a pin's head to a bean. Soil sterilization is the only remedy (see p. 11).

#### IRREGULAR FRUITS

are common. If numerous in a crop, fresh seed should be obtained and this should be selected from a source bearing smooth fruits, since the shape of the fruit is to some extent transmitted by the seed.

#### IRREGULAR LUMPS

on the stems of plants are the subject of inquiry occasionally from inexperienced growers, who look upon them as some form of disease. Those seen have been merely the beginning of secondary roots at points low down on the stem where they were in moist situations or touched the soil.

#### FALSE MOLD.

In a few cases a black mold has been complained of by tomato growers on young plants in the hotbed. This has been due to spores of a common toadstool (*Coprinus* sp.), which grew abundantly in the manure of the hotbed, shed its spores and disappeared. The spores were plentifully deposited on the leaves and greatly resembled a mold. These spores are of course harmless.

#### A BACTERIAL BLIGHT

in the stems of greenhouse plants has been noted several times, though in only a few cases. The infection evidently entered the stem by way of a wound, dead shoot, or leaf stalk. The parasite causes a yellow discoloration down and up the stem from this point with a dark streak in its centre.



